X-Ray & ABS

Circuit/Mechanical Descriptions

Overview

The OEC UroView® 2800 Generator is part of a family of compact high frequency X-Ray generators. The various generators operate on the following voltage and wattage ranges:

Three Phase 480 VAC	80 kW	65 kW
Three Phase 400 VAC	80 kW	65 kW
Single Phase 208 VAC	40 kW	

The generators are capable of handling 1msec to continuous exposures ranging from 1 mA up to 600 mA, with constant potential independent of line voltage variations. Power generation is by a high-frequency converter (High voltage ripple: 40KHz-140KHz) with low kV and mA ripple, excellent accuracy and dose reproducibility.

The generators also include a thermal load interactive integrator ensuring optimum use of the heat protection curve of the x-ray tube and feature efficient installation (no generator calibration), and application error codes to ensure fast troubleshooting.

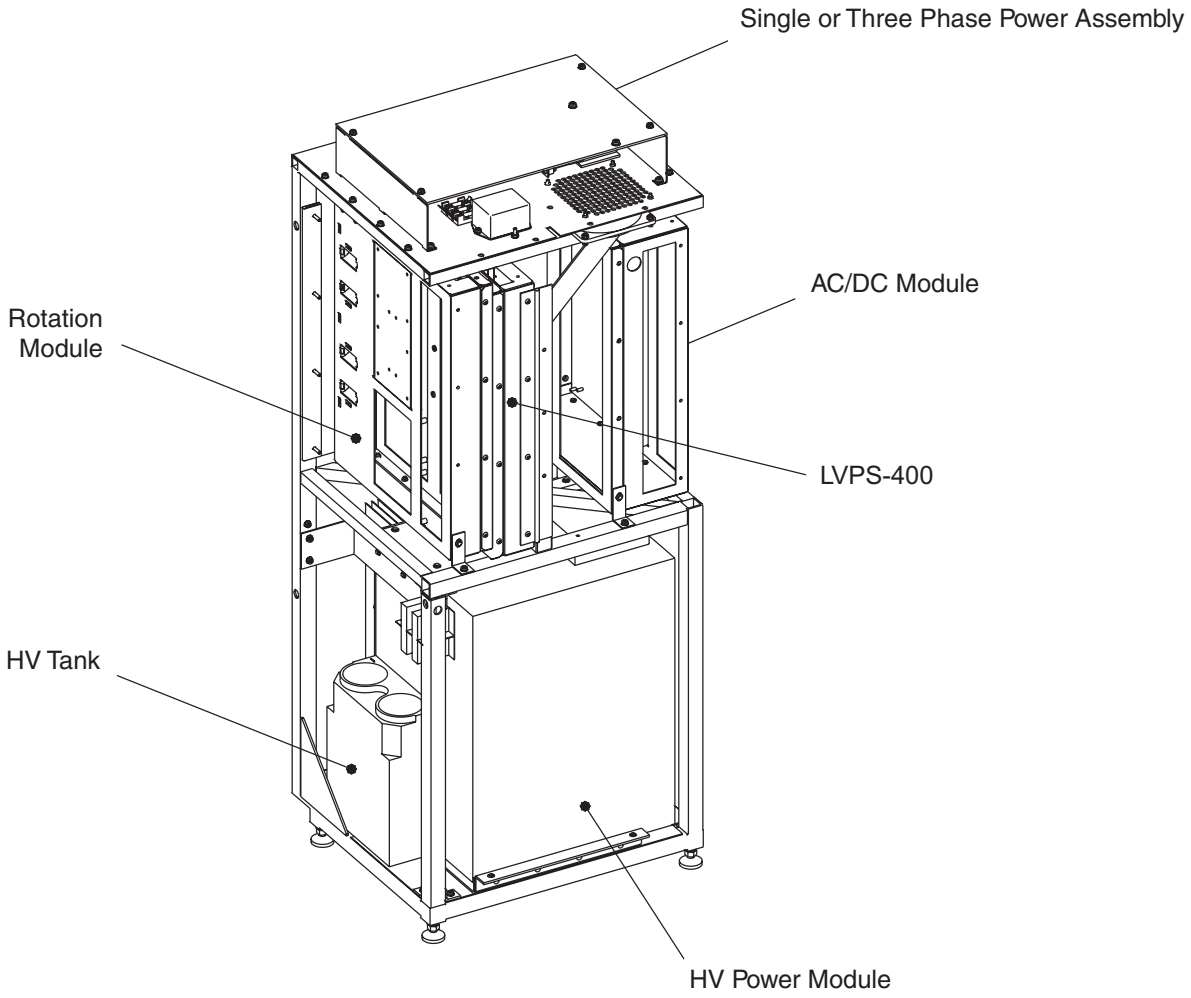
The generator is composed of a high voltage chain including the kV Control PCB, power inverter and HV Tank, Anode Rotation PCB, Tube Filaments Heater PCB, and a control bus for communication between the functions. A DC bus is utilized for power distribution to each function, input voltage for DC conversion, an AC/DC function, a low voltage power supply, and application software, running on the kV Control PCB.

The above high voltage chain components are located in four chassis box compartments of the generator chassis. The Rotation Module contains the Rotation PCB, while the LVPS-400 module contains the Low Voltage Power Supply and the large and small Heater Filament PCBs. (Refer to the *Generator Assembly Diagram* on the following page.)

The AC/DC Module contains the EMC Filters, the AC/DC Power Supply and the Capacitor and Rectifier assembly.

The inverter block is composed of two assemblies, the High Voltage tank and the Inverter power assembly. The High Voltage tank contains the kV measure along with high voltage power components and connections for the HV Cables for the X-ray tube. The Inverter power assembly contains the Generic Interface PCB, AEC PCB, the PPC kV Control PCB, the IGBT PCB and the Gate Command PCB.

The physical location of the modules within the generator frame assembly is shown in the following illustration. The three modules on the top level are hinged to swing outward from the chassis frame for easy replacement in case of failure.



Generator Assembly Diagram

Power-on Sequence

Generator power-on is achieved by various means, depending on system configuration (circuit breaker, console ON/OFF, PDU contactor). In all cases, generator power-on starts when input power is applied.

For a three-phase generator, the low voltage power supply utilizes 220V supplied by the system independently of the three-phase input. It provides ±15V to the 15-volt bus (Rotation LEDs DS1andDS2 are turned ON).

The +15V rise triggers the 5V rise on the kV Control, Heater and Rotation PCBs (LED DS3 is turned ON).

For single-phase Generator, a DC voltage (400VDC, DS2 turned on) is provided on the AC/DC PCB to supply the low voltage power supply (NE1) as soon as the input power is applied. The low voltage power supply starts provides ±15V to the 15-volt bus (Rotation LEDs DS1 and DS2 are turned ON) and the 160VDC (DS1) is provided to the Heater PCB.

The +15V rise triggers the 5V rise on the kV Control, Heater and Rotation PCBs (LED DS3 turned ON).

At this stage, many actions occur in parallel on the other generator PCBs. These actions are described for each PCB within this manual section.

Exception handling

The generator software performs an auto-test at power up and continuously monitors the correct operation of the generator functions during application. Any error stored in the error log is reported to the system through a protocol that transfers the error code.

Errors found can only be reported if the generator is powered on. A list of error codes is contained in the *Diagnostics* section of this manual.

CANbus

The CANbus is a network developed and standardized by the automobile industry. Its main purpose is to transport short command messages with a guaranteed latency and without any information loss. Defined for small systems, it does not require large amounts of software to encode and decode the messages.

The CANbus is used for communications between the Table/Generator Interface PCB and the generator.

Rotor Control and Braking

The rotation function involves the Rotation PCB, the rotation capacitors module and the tube stator. The high-speed Rotation PCB utilizes a low speed of 60 Hz for 3600 rpm and 160 Hz for 9600 rpm.

High Speed Rotation

Since the rotation function is regulated by an inverter that consists of six Insulated Gate Bipolar Transistors (IGBTs). The inverter drive uses Pulse Width Modulation (PWM) for the IGBT commands. A periodic command is sent to the IGBTs equal to the speed selected to generate a sine wave current in each phase at the anode speed frequency with the optimum angle between the phases.

The rotation drive mainly relies on a micro-controller that is in charge of the rotation functions, including getting the power-up rotation database containing the data required to drive the stator (through the CAN Bus). The database also contains current references for each state, acceleration and brake duration, and current inverter safety levels.

The micro-controller receives speed and braking commands, and controls the rotation accordingly. It measures the inverter currents, regulates the inverter (fundamental and modulation), and relays error feedback to the main software. It also puts the rotation in a safe state in case of error, reads the tube safety parameters, and drives tube cooling.

All rotation states are regulated except the brake. Braking includes a state where a DC current is generated in open loop mode, with the frequency of the commands dependent on the tube and the line voltage.

Tube Heat Sensing

The high-speed Rotation PCB also handles supply and reading of two tube thermo-switches (typically, 80° C). The information is sent to the main software for appropriate actions based on the tube and system.

X-Ray On/Disable

When an X-ray control is pressed, the X-ray security line logic is checked for a mismatch with the X-ray control by the CPU on the Table/Generator Interface PCB. If a mismatch occurs between the X-ray security line and the X-ray controls, a TABLE FOOT SWITCH ERROR message is displayed. (This error applies to the left or right X-ray controls and not to the Mode switch because a hardware security line is not provided for the mode switch.)

The generator monitors the X-ray control lines and reports an error if any are active in the standby state.

The X-RAY SWITCH STUCK message is displayed when an X-ray control is sensed in an “on” state (stuck) during system startup. This error applies to the Left or Right X-ray controls.

Generator Control

Manual kVp Control

The manual kVp control key on the X-Ray Control Console allows manual settings of the kVp value by the operator. When pressed, the key is sensed by the X-Ray Control Console Switch Matrix. The command to increase or decrease the kVp value is sent to the console X-Ray Control Console Interface PCB and is delivered to the X-Ray Control Console CPU card plugged into the X-Ray Control Console Backplane.

The output control signal from the CPU card via the X-Ray Control Interface PCB is then sent via ARCnet to the Table/Generator Interface Card.

The command to increase or decrease kVp is then relayed by CANbus to the Generator Power Module Generic Interface card. This “standard” interface PCB provides a CAN bus communication line for command signals between the generator and the system. The Interface card passes the command to the kV Control PCB.

The kV Control PCB functions as the main control of the generator. The CPU in this card passes the manual kVp command to the kV Measure PCB, which resides on top of the HV Tank. (The HV Tank is sealed by the kV Measure PCB secured to the top of it. This PCB must not be removed.) The kV Measure PCB controls the HV Tank by applying a kV Reference to the kV Measure PCB in preparation for an exposure.

When the exposure is enabled, the kV Control PCB CPU receives the exposure enable signal, applies the filament drive, and enables the anode rotation function. In addition, it measures kV demand, kV Measure, DC Bus, gate voltage and HV Tank temperature during the exposure.

The CPU also applies any new kV and mA reference if the parameters are changed manually by the operator.

The exposure control of the CPU starts the HV Power Inverter by driving the HV Tank IGBTs and puts the generator in it’s active state, regulating the inverter and monitoring the hardware for safety issues.

Manual mA/mAs Control

The manual mA/mAs control key on the X-Ray Control Console allows manual setting of the mA/mAs value by the operator for film or fluoroscopy. When pressed, the button code is sensed by the X-Ray Console Switch Matrix. The code to increase or decrease the mA/mAs value is sent to the X-Ray Control Console Interface PCB and is delivered to the X-Ray Control Console CPU card plugged into the X-Ray Control Console backplane.

The output command from the CPU card via the X-Ray Control Interface PCB is then sent via ARCnet to the Table/Generator Interface Card.

The mA/mAs change command is then relayed by CAN bus to the Generator Power Module Generic Interface card. This “standard” interface PCB provides a CAN bus communication line for command signals between the generator and the system. The Generic Interface card passes the command to the kV Control PCB.

The mA/mAs command is received by the card CPU along with the kV and exposure time commands. When the CPU receives the exposure enable signal, it calculates the acquisition filament drive to apply to the tube filament to match the required tube mA.

This calculation is based on the filament drive values stored in the tube database and the interpolation required to calculate the filament drive for the kV and mA point selected manually by the operator. In addition, the CPU takes into consideration a correction for aging of the filament.

The CPU then calculates the filament boost required and applies a 400 ms boost duration, followed by the acquisition command to the filament heater function.

The CPU sends a new filament drive to the heater function each 1ms and updates the mA command if it has been changed by the operator or a generator algorithm (ABS mode, falling load mode, or variable mA mode). The CPU also checks the accuracy of the mA value.

When the exposure command goes into the inactive state, the CPU either stays with the last filament drive command value, goes into a preheat mode for the next exposure or stops filament drive to allow filament cooling before preheating starts. The state of the CPU depends upon the application called for by the operator from the X-Ray Control Console.

Auto Fluoro Mode

The Auto Fluoro Mode button on the X-Ray Control Console enables Automatic Brightness Stabilization (ABS) control of the kVp, mA, and camera gain technique. When the Auto Fluoro Mode button is pressed, the button code is sensed by the X-Ray Console Switch Matrix. The code is sent to the console X-Ray Control Interface PCB and is delivered to the X-Ray Control Console CPU card plugged into the X-Ray Control Console backplane.

The output control command from the CPU card via the X-Ray Control Interface PCB is then sent via ARCnet to the CPU of the Table/Generator Interface Card. While the system is in Auto Fluoro, kV, mA, and Camera gain are automatically adjusted by the CPU using the standard ABS tables provided by software.

The technique when entering Auto Fluoro (from Manual Fluoro) is selected from the standard ABS table by matching the closest kVp value to the last Manual setting for kVp.

The system adjusts the technique as necessary so as not to exceed a 20 R/minute dose maximum for all continuous HLF X-rays. The system also adjusts the technique as necessary so as not to exceed a 10 R/minute dose maximum for all continuous non-HLF X-rays.

All non-film X-rays begin with non-HLF, continuous X-ray generation. If, on the 3rd frame after X-rays have begun, the image is stable, the software begins the requested X-ray type: HLF, Pulse Fluoro, Digital Cine or Continuous Fluoro.

If, on the 3rd frame, the image is NOT stable, the software begins an ABS servo with non-HLF, continuous X-ray generation until Video Stable is achieved. Video Stable is achieved when the image value is within the tolerance value (Video Stable Window) of the Video Stable as set by Utility Suite software.

Auto Brightness Stabilization Control (ABS)

The Auto Brightness Stabilization (ABS) automatically adjusts kVp, mA, and Camera Gain for an optimal image by comparing the video level from the camera to a reference level contained in the video level index. The standard functions adjusted are dependent on the Fluoro mode selected and are shown in the following tables:

ABS Control during Auto Fluoro Mode

Function	Description
kVp	ABS adjusts the kVp index value until the video level equals the value contained in the video level index.
mA	ABS adjusts the mA value.
Camera Gain	ABS adjusts the Camera Gain
Camera Iris	Iris fully open

KVp, mA, and Camera Gain are “looked up” in an ABS table and set accordingly.

ABS Control during Manual Fluoro Mode

Function	Description
kVp	Manual adjustment of kVp value.
mA	Manual adjustment of the mA value.
Camera Gain	ABS adjusts the Camera Gain until the video level equals the value contained in the video level index
Camera Iris	Iris fully open

ABS Control during Pulsed Boost Fluoro Mode

Function	Description
kVp	kVp frozen at its current value by software.
mA	mA is incremented until the video level equals the video level index.
Camera Gain	Camera Gain is reduced, and the ABS system adjusts mA to achieve correct video level. If the correct video level is not reached before the mA limit is reached, the camera gain is increased.
Camera Iris	Iris fully closed.

ABS Control during Boost Fluoro Mode

Function	Description
kVp	kVp frozen at its current value by software.
mA	mA is incremented until the video level equals the video level index.
Camera Gain	Camera Gain is reduced, and the ABS system adjusts mA to achieve correct video level. If the correct video level is not reached before the mA limit is reached, the camera gain is increased.
Camera Iris	Iris fully open.

Pulse

Pulsed X-rays can be used to reduce the total patient radiation exposure, but are not used with film or digital spot mode. A preset number of X-rays are generated while the Pulse button is pressed. Pulsed X-rays are available to any Fluoro mode, whether Auto or Manual Fluoro.

Pressing the Pulse button on the X-Ray Control Console to enable pulsed imaging uses the pulse rate as currently selected from the Workstation MODE screen. Pulse rates are:

System Video Rate	Displayed Rate	Real System Pulse Rate	Pulse Width in ms
30 FPS	1	1	50
30 FPS	2	2	50
30 FPS	4	3.75	50
30 FPS	8	7.5	30
30 FPS	15	15	25
25 FPS	1	1	50
25 FPS	2	2.083	50
25 FPS	4	4.167	50
25 FPS	6	6.25	30
25 FPS	12	12.5	25

When pressed, the Pulse button is sensed by the X-Ray Console Switch Matrix. The button code to enable the mode is sent to the console X-Ray Control Interface PCB and is delivered to the X-Ray Control Console CPU card plugged into the X-Ray Control Console Backplane. The CPU checks to see if the system is in Film or Digital Spot Mode, or if an exposure is underway, and if not, allows the Pulse command to be sent.

The output control signal from the CPU card via the X-Ray Control Interface PCB is then sent via ARCnet to the Table/Generator Interface Card. The state of pulsed imaging is also communicated to the Workstation when the state changes. This is done so the Workstation Status Indicator bar can indicate that pulsed imaging is enabled.

The pulse command is transferred via CAN bus to the generator interface PCB and passed on to the kV Control PCB. The kV Control PCB CPU commands the generator to go into pulse mode using the pulse rate set up from the Workstation MODE screen.

Low Dose

The Low Dose Mode button on the X-Ray Control Console enables Low Dose Automatic Brightness System (ABS) table control of the kVp, mA, and camera gain technique. Pressing the button turns on the button LED to indicate the mode has been enabled.

When the Low Dose Mode button is pressed, the button code is sensed by the X-Ray Console Switch Matrix. The code is sent to the console X-Ray Control Interface PCB and is delivered to the X-Ray Control Console CPU card plugged into the X-Ray Control Console Backplane.

The output control command from the CPU card via the X-Ray Control Interface PCB is then sent via ARCnet to the Table/Generator Interface Card. While the system is in Low Dose mode, kV, mA, and Camera gain are automatically adjusted using the Low Dose ABS tables.

Pressing the Low Dose button a second time turns off its LED and reloads the Standard ABS tables for ABS servo operation.

X-Ray Footswitch

The four-position X-Ray Footswitch controls x-ray exposures and video. The two-position footswitch contains only Fluoro and High Level Fluoro x-ray control switches. The switches in both footswitches are identical.

When a button on either footswitch is pressed for Fluoro or High Level Fluoro, the button code is sent directly to the Table/Generator Interface PCB. The interface card sends the button code to its CPU and a command for the selected mode is relayed via ARCnet to the system for display and execution. The command is sent on the CANbus to the Generator Generic Interface PCB and then to the kV Control PCB CPU to control the exposure.

The footswitches receive power via the I-Source line. This line delivers current from the Table/Generator Interface card to the switch. Activation of the footswitch causes current to flow from the I-Source line to the Fluoro line and then through an opto-isolator on the Table/Generator Interface PCB. When active, this input port calls for the exposure to be made by the system software.

The Security line is also activated along with the Fluoro line. The processor reads status of the input ports and determines that one or more of the four security lines is asserted or set high. These lines are the Table, X-ray Console, Collimator, and voice. The Security line active status is combined with the interlock status to determine if the exposure can proceed.

The Fluoro and High Level Fluoro buttons are also available on the X-ray Control Console. When either button is pressed, the button code is sensed by the X-Ray Console Switch Matrix. The code is sent to the console X-Ray Control Interface PCB and is delivered to the X-Ray Control Console CPU card plugged into the X-Ray Control Console Backplane. The output control command from the CPU card via the X-Ray Control Interface PCB is then sent via ARCnet to the Table/Generator Interface Card.

Fault Isolation

Test:	Failure:	Check:
Perform Stator Motor Test	DS1 and DS2 are off No whirring sound?	Interlock circuit Analog interface outputs
	Error Message displayed	Pwr/Mtr relay CB2 Phase Capacitor C5 Stator motor wire harness and transformer. (See *Diagnostics* section.)
kVp/mA Servo Loop Test	Error message displayed No manual kV, mA control	Check the ABS control circuitry, camera alignment and image intensifier (See *Diagnostics* section.)
Perform the Auto Technique Tracking Test	Failed to servo to correct kVp range with copper filter inserted	Check the ABS control circuitry, camera alignment and image intensifier
Perform the Boost Test	No audible alarm mA doesn't adjust Image too dark or too light	Check the ABS control circuitry, camera alignment and image intensifier
Perform the Pulsed Boost Test	No audible alarm mA doesn't adjust	Check the ABS control circuitry, camera alignment and image intensifier
Perform Fluoro Timer and Timer Test	Alarm does not reset Accumulated Timer display does not reset to 0 after five second ALARM RESET button hold	Check configuration of the options.dat file

Test:	Failure:	Check:
Perform the Generator Functional Check	mA, mAs max/min values out of tolerance.	Perform Generator Performance Check. Check individual PCB adjustments as shown in *Adjustments* section. (See *Diagnostics* section.)

Functional Tests

Beam Alignment Verification

Omit the Film portion of this procedure when verifying Beam Alignment on systems without film capability. For regulatory purposes, SID measurements are: Film = 45 inches, Fluoro = 47 inches. If Beam Alignment Verification fails, perform a Beam Alignment procedure. Refer to the *Calibration* section of the *2800 Service Manual*.

Fluoro Alignment

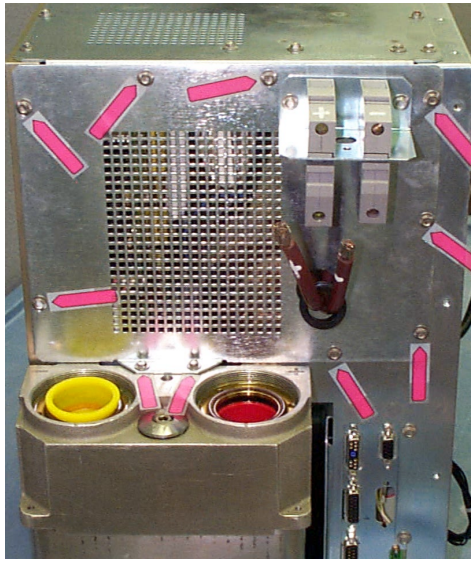
1. With Auto Fluoro enabled, take a NORM field shot and verify all four leaves show in the image.
2. Take a MAG1 field shot and verify all four leaves show in the image.
3. Take a MAG2 field shot and verify all four leaves show in the image.
4. Turn on the Collimator Lamp.
5. Select Fluoro Mode and verify you can collimate to less than 5 cm x 5 cm, as indicated by the illuminated area.

Film Alignment

1. Set the technique to 40 kVp @ 100 mAs and enable AEC mode.
2. Fully open the collimator leaves and then move the leaves inward approximately 1 inch.
3. Take a film exposure and then develop the film.
4. Fold the film and verify longitudinal centering is within 0.45 inches (1% x 45-inch film SID).
5. Fold the film and verify lateral centering is within 0.45 inches.
6. Take another film shot with the collimator leaves fully open. Verify at least three edges of the X-ray beam can be seen on the film.
7. Turn on the Collimator Lamp.
8. Select Film Mode and verify you can collimate to less than 5 cm x 5 cm, as indicated by the illuminated area.

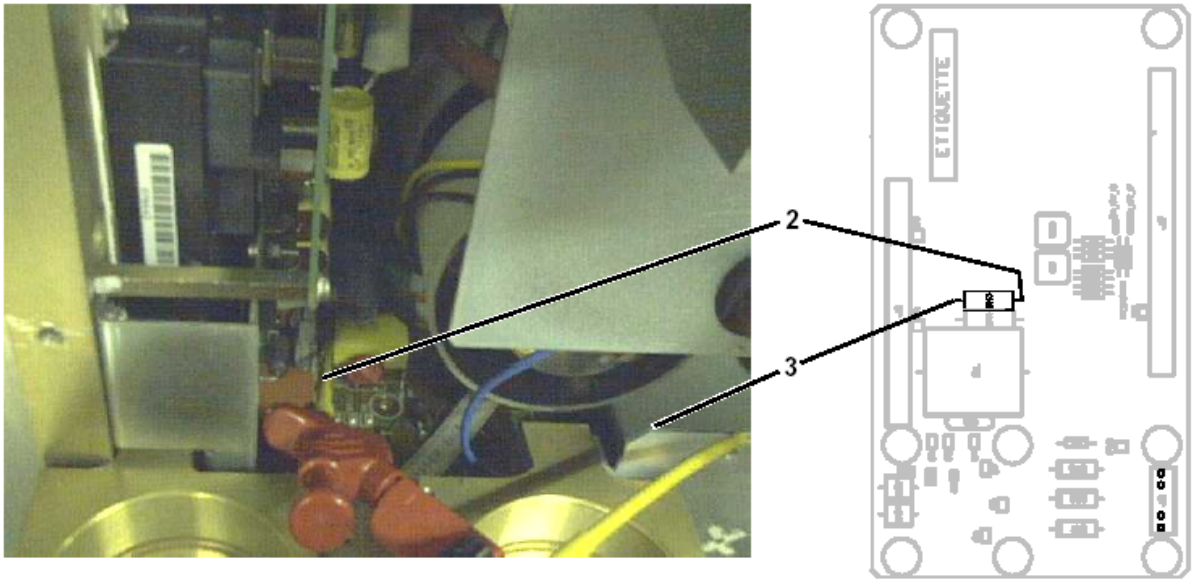
Disassembly

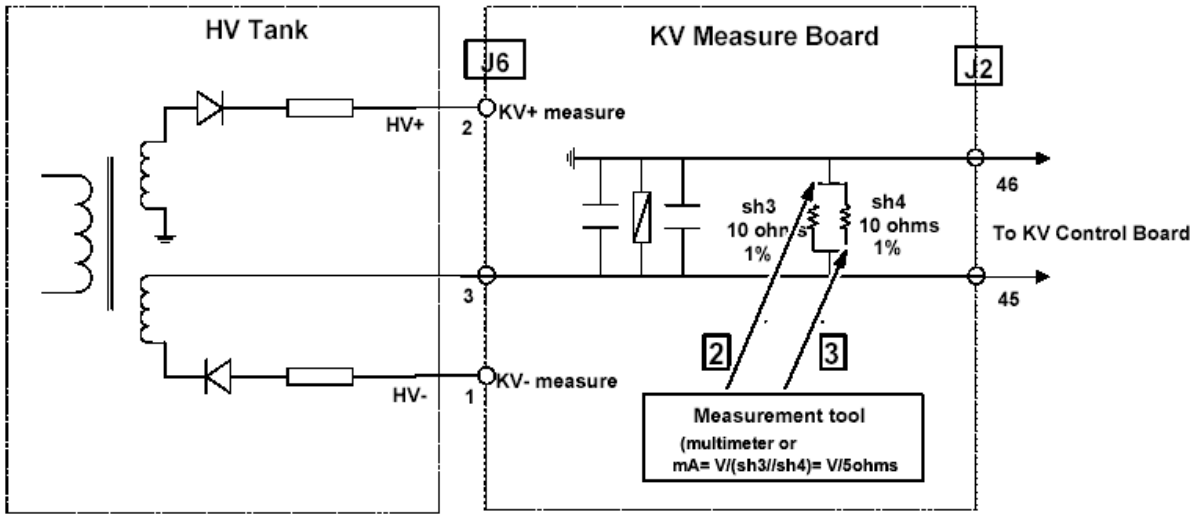
The Invasive mA Measure can be made only on the left side of the Inverter Unit. (Refer to the *Generator Assembly Diagram* in this section.)



1. Unscrew the screws (see note below) securing the two EMC cover panels (1) on the HV connections side and remove them.

Note: Do not to let screws fall into the HV connector receptacles. Cover the receptacles with plastic caps.


2
3


HV Tank
KV Measure Board
J6
J2
HV+
2
KV+ measure
46
To KV Control Board
sh3
10 ohms
1%
sh4
10 ohms
1%
3
45
2
3
HV-
1
KV- measure
Measurement tool
(multimeter or
mA= V/(sh3//sh4)= V/5ohms

2. Put a probe inside the generator on the shunt SH3 (left side of the resistor or the big yellow capacitor in parallel, C8 of kV Measure PCB on HV Tank (2).
3. Connect a second probe on the mechanical ground (3).
4. Check the resistor value with a multi-meter. It should be 5 ohms (± 0.05).

X-Ray Stator Test

1. Apply power to the system.

Caution: *Do not operate the system if the stator motor cannot be heard and is not operating.*

2. Verify that the stator motor is rotating by listening for the “whirring” sound coming from the X-ray tube head.
3. Verify that the control Panel does not display the error message “Stator not on.” If the message is displayed, refer to the *Diagnostics* section of this manual and correct the problem.

kVp/mA Servo Loop Test

WARNING: *Steps within this procedure produce x-rays. Use appropriate precautions.*

1. Select MANUAL FLUORO mode and set the technique for 40 kVp @ 4 mA.

2. Verify that the kVp and mA can be controlled using the control panel switches.

3. Press the X-RAY ON switch and verify that no error messages are displayed on the Control Panel Display. If an error message is displayed, go to the *Diagnostics* section of this manual and correct the fault.

Auto Technique Tracking

WARNING: *Steps within this procedure produce x-rays. Use appropriate precautions.*

1. Select Auto Fluoro mode and the NORM field size
2. Verify that the kVp tracks accurately according to the following table, as copper filters are inserted into the field. Tape the filters to the Collimator – Do not lay them on the table.
3. Record the kVp value in the table:

Copper Filters	kVp range
1	61 kVp ± 3 kVp
2	71 kVp ± 3 kVp
3	79 kVp ± 3 kVp

Boost

WARNING: *Steps within this procedure produce x-rays. Use appropriate precautions.*

1. Place a copper filter on the Image Intensifier. Enable BOOST on the control panel by pressing the BOOST ENABLE button.
2. Select AUTO FLUORO mode and take an exposure. Once the image has stabilized, take another exposure by pressing the BOOST footswitch.
3. Verify that the audible alarm beeps at twice the normal rate.
4. Verify that the mA elevates until the image becomes stable.
5. Observe that the image doesn't "burn out" or appear too dark.

Pulsed Boost

WARNING: *Steps within this procedure produce x-rays. Use appropriate precautions.*

1. With BOOST enabled, select PULSE on the control panel.
2. Select AUTO Fluoro mode and take an exposure. Once the image has stabilized, take another by pressing on the BOOST footswitch.
3. Verify that the audible alarm beeps at twice the normal rate.
4. Verify that the mA elevates until the image becomes stable.

Verify Fluoro Timer and Timer Test

1. In FLUORO mode, the accumulated exposure time is displayed in the center of the display panel. After five minutes of accumulated fluoro x-rays, the timer alarm will sound.
2. Press ALARM RESET to reset the alarm. The alarm will stop, but the accumulated exposure display will not reset.
3. Press and hold the ALARM RESET for five seconds. The accumulated timer display will reset to zero (0).

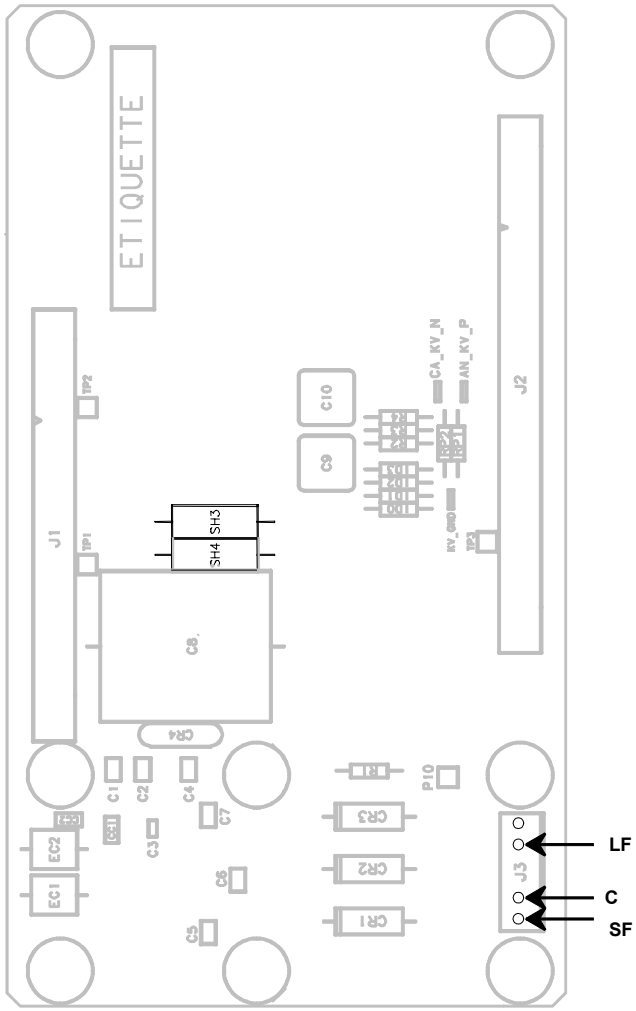
Generator PCB LEDs

Introduction

This section shows the circuit boards of the OEC Uroview® 2800 generator. In the illustrations, the main indicators (LEDs and fuses) are detailed.

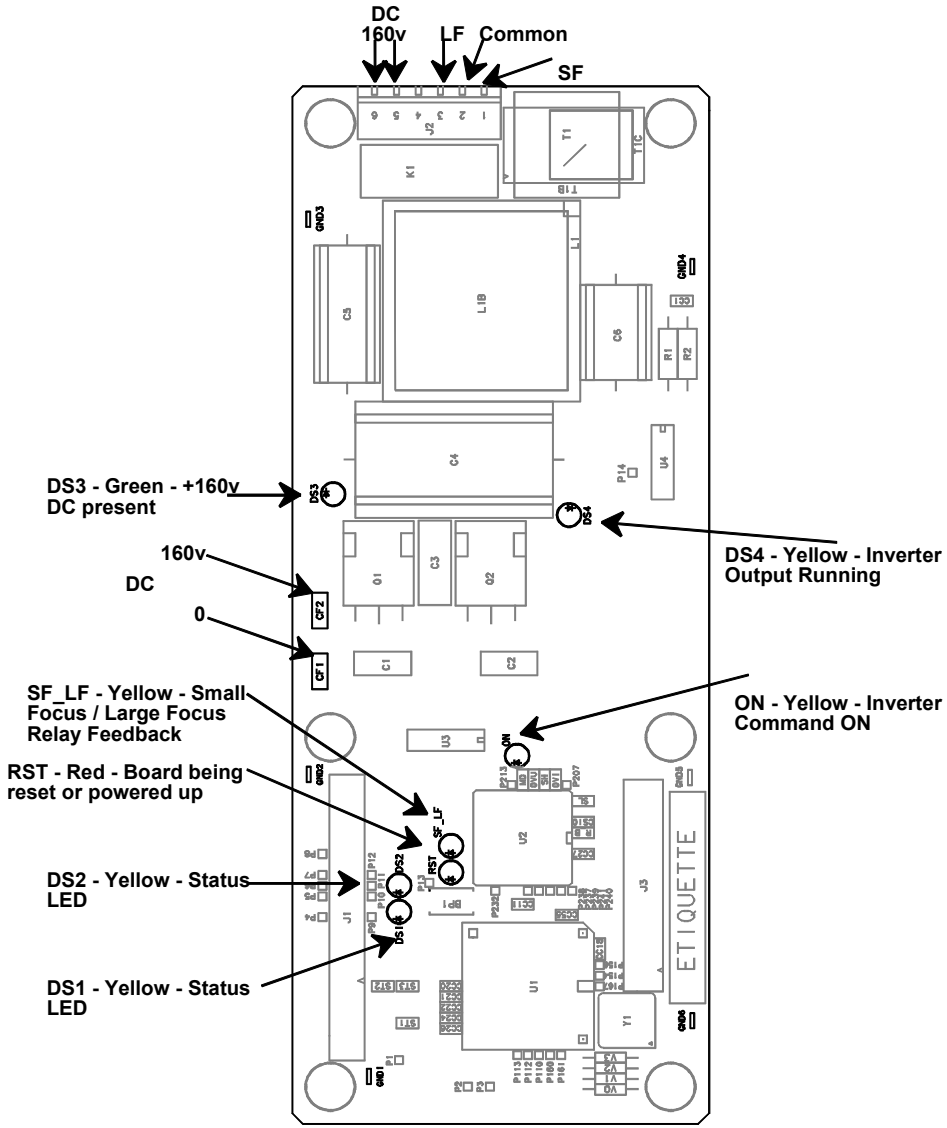
kV Measure PCB

Caution: *This board forms part of the oil seal of the High Voltage Tank. It can only be removed at the factory. The Field Replaceable Unit (FRU) is the complete HV Tank.*


ETIQUETTE
J1
J2
J3
C10
C9
C8
SH3
SH4
LF
C
SF

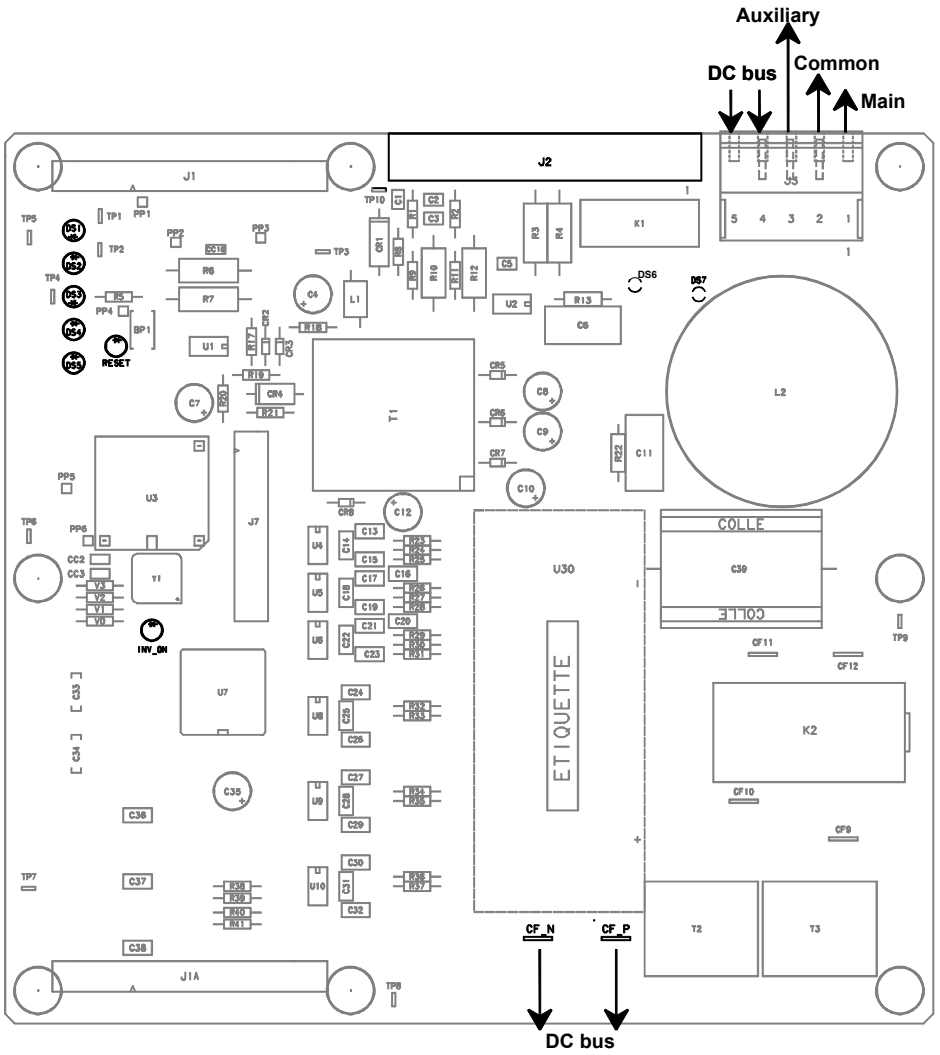
Filament Drive PCB

WARNING: *High Voltage: Do not attempt to service the generator until indicator DS3 is extinguished.*


DC
160v
LF
Common
SF
DS3 - Green - +160v
DC present
160v
DC
0
DS4 - Yellow - Inverter
Output Running
SF_LF - Yellow - Small
Focus / Large Focus
Relay Feedback
ON - Yellow - Inverter
Command ON
RST - Red - Board being
reset or powered up
DS2 - Yellow - Status
LED
DS1 - Yellow - Status
LED
ETIQUETTE

Rotation PCB

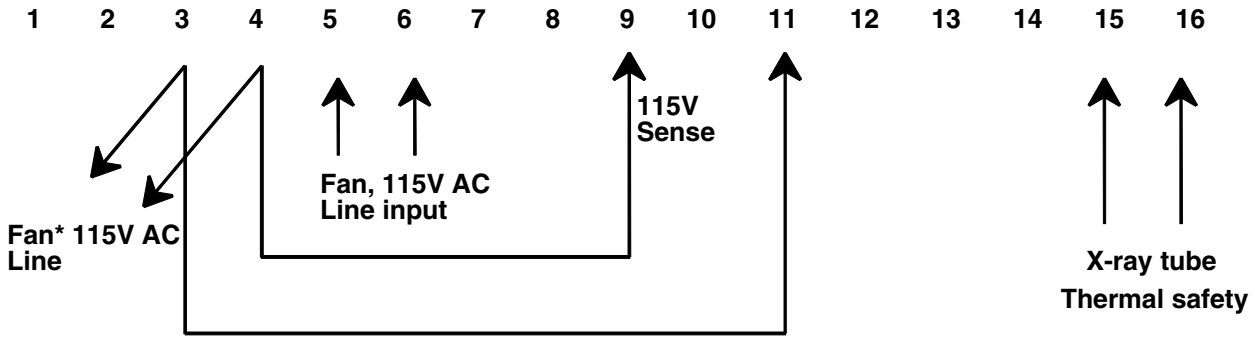
WARNING: *High Voltage: Do not attempt to service the generator until indicators DS6 and DS7 (neon-orange) are extinguished. Even when the LEDs are extinguished, the voltage could still be over +90 volts. Check the DC Bus first with a DVM before performing any service on this PCB.*


Auxiliary
DC bus
Common
Main
J1
J2
K1
L2
T1
U3
U7
U30
J7
J1A
K2
T2
T3
ETIQUETTE
COLLE
RESET
INV_ON
CF_N
CF_P
DC bus

Indicators

INDICATOR	COLOR	INDICATES:
RESET	Red	BOARD BEING RESET OR POWERED UP
INV_ON	Yellow	THE INVERTER IS RUNNING
DS1	Green	PRESENCE OF +15 V SUPPLY
DS2	Green	PRESENCE OF -15 V SUPPLY
DS3	Green	PRESENCE OF +5 V SUPPLY
DS4-DS5	Yellow	BOARD STATUS
DS6	Neon (orange)	FAN VAC POWER SUPPLY PRESENT
DS7	Neon (orange)	DC BUS PRESENT

J2 Wiring

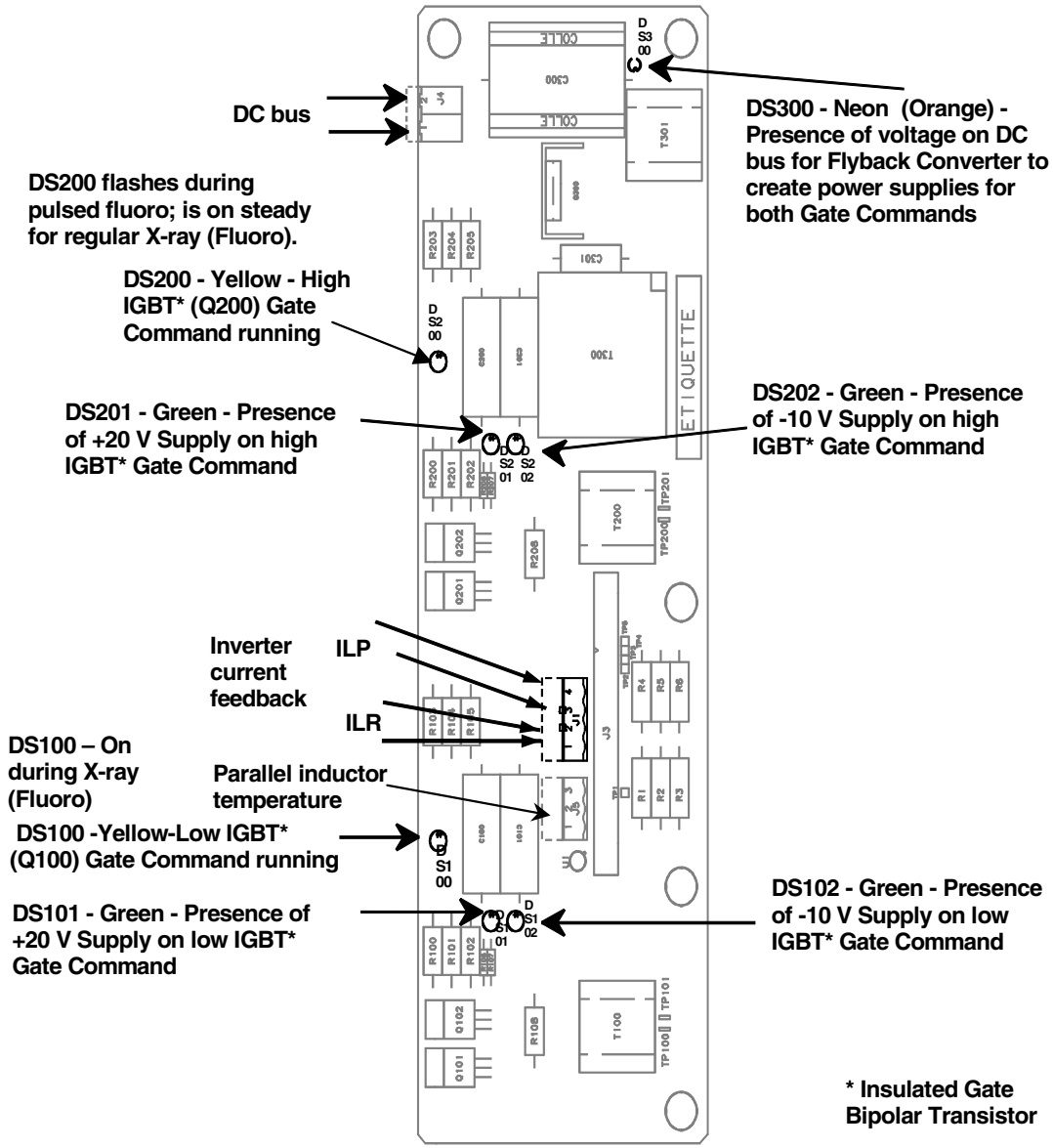


*** used for fan cooling tube**

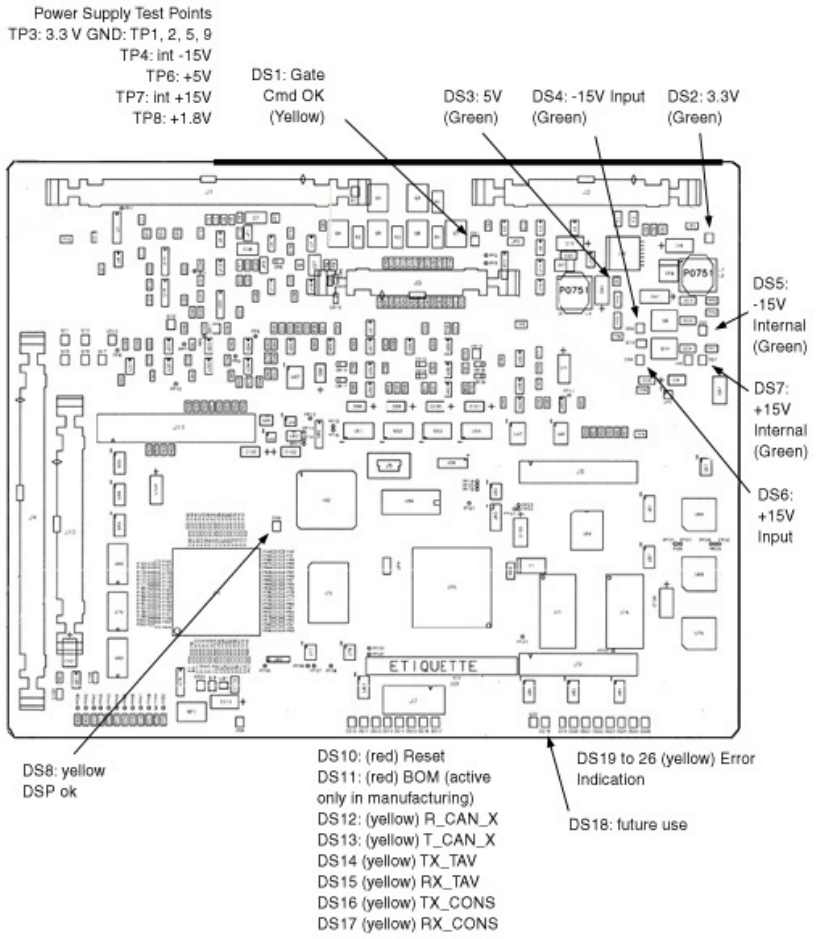
Gate CMD PCB

WARNING: *High voltage: Do not touch this PCB until DS300 on this PCB and DS1 on the Dual Snubber PCB are extinguished.*

Caution: *Hot surface on transformer T300 and heat sink.*


DC bus
DS200 flashes during pulsed fluoro; is on steady for regular X-ray (Fluoro).
DS200 - Yellow - High IGBT* (Q200) Gate Command running
DS201 - Green - Presence of +20 V Supply on high IGBT* Gate Command
Inverter current feedback
ILP
ILR
DS100 – On during X-ray (Fluoro)
Parallel inductor temperature
DS100 -Yellow-Low IGBT* (Q100) Gate Command running
DS101 - Green - Presence of +20 V Supply on low IGBT* Gate Command
DS300 - Neon (Orange) - Presence of voltage on DC bus for Flyback Converter to create power supplies for both Gate Commands
DS202 - Green - Presence of -10 V Supply on high IGBT* Gate Command
DS102 - Green - Presence of -10 V Supply on low IGBT* Gate Command
* Insulated Gate Bipolar Transistor

kV Control PCB



Switches and Jumpers

SWITCH OR JUMPER	FUNCTION
RST	RESET PUSH BUTTON

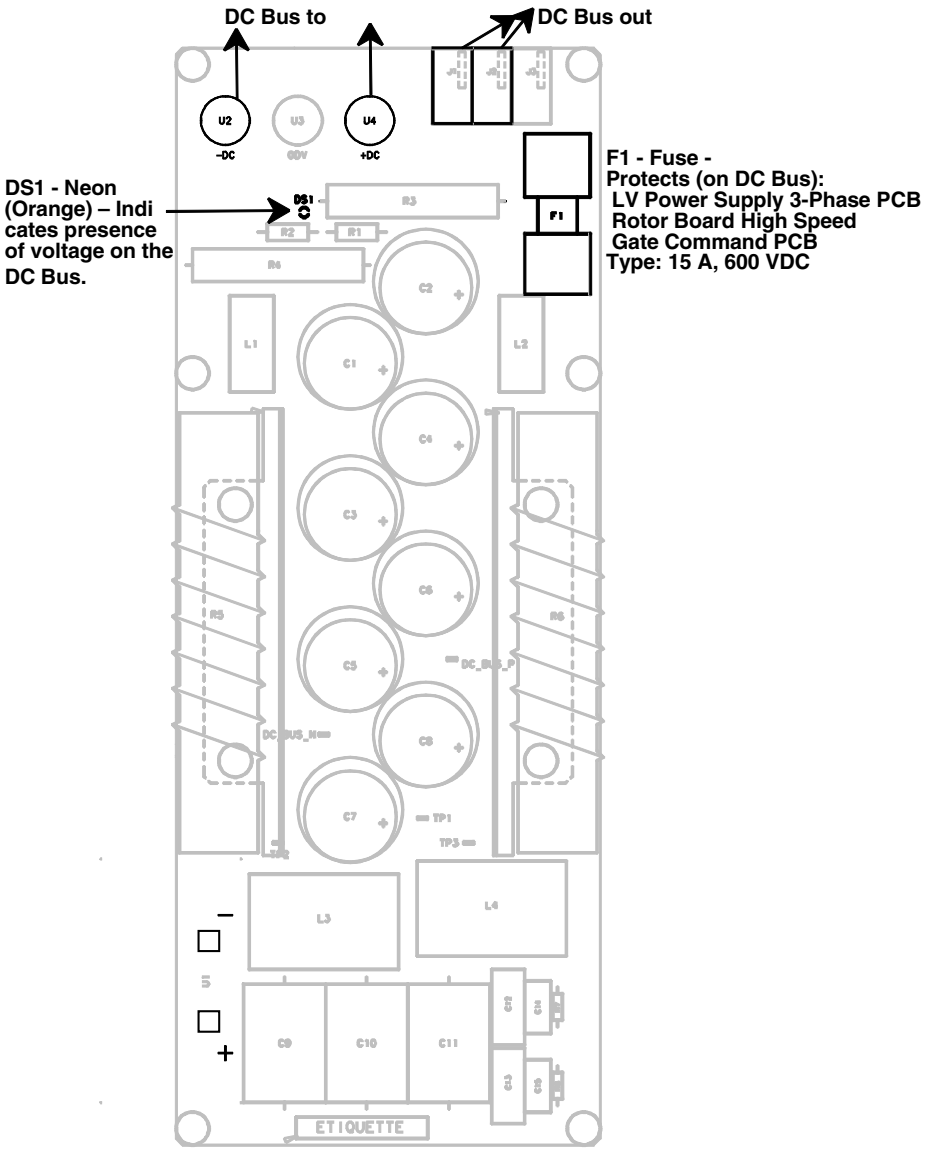
Indicators

INDICATOR	COLOR	INDICATES:
CONF	Red	FIELD PROGRAMMABLE GATE ARRAY (FPGA) CONFIGURATION NOT ACCOMPLISHED
OK	Yellow	INVERTER GATE POWER SUPPLY OK
TX_TAV	Yellow	TRANSMIT TO SERVICE LAPTOP
RX_TAV	Yellow	RECEIVE FROM SERVICE LAPTOP
TX_CONS	Yellow	TRANSMIT TO CONSOLE (IF EXISTING)
RX_CONS	Yellow	RECEIVE FROM CONSOLE (IF EXISTING)
T_CAN_X	Yellow	SYSTEM CAN BUS TRANSMIT
R_CAN_X	Yellow	SYSTEM CAN BUS RECEIVE
HALT	Red	MICROPROCESSOR HALTED
RESET	Red	BOARD BEING RESET
S0 TO S7	Yellow	STATUS LED IN APPLICATION MODE THESE LEDS FLASH IN SEQUENCE CONTINUOUSLY
DS1	Green	-15V SUPPLY
DS2	Green	+15V SUPPLY

AC/DC 3-Phase PCB

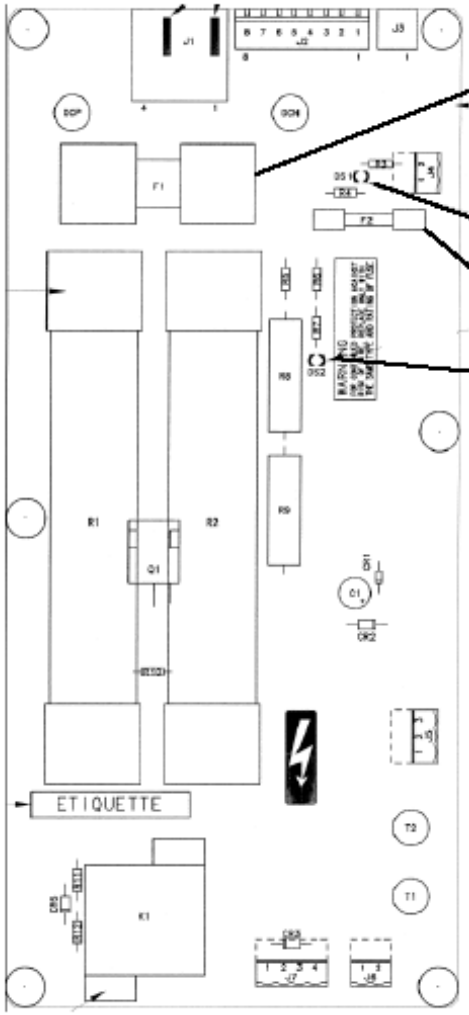
WARNING: *High voltage: Do not attempt to service generator until DS1 (neon - orange) is extinguished. Even when the LEDs are extinguished, the voltage could still be over +90 volts. Check the DC Bus first with a DVM before performing any service on this PCB.*

Caution: *Some components on this board can become very hot.*


DC Bus to
DC Bus out
DS1 - Neon (Orange) – Indi cates presence of voltage on the DC Bus.
F1 - Fuse -
Protects (on DC Bus):
LV Power Supply 3-Phase PCB
Rotor Board High Speed
Gate Command PCB
Type: 15 A, 600 VDC
U2
U3
U4
-DC
GDV
+DC
DS1
F1
ETIQUETTE

AC/DC Single Phase PCB

This PCB is only used with the single-phase generator.



F1: DC bus fuse, 15AFF 700 Vdc.

Protects Rotation PCB

DS1: Orange light = presence of 220V

F2: 220V fuse. Protects LVPS-400. Rate 3.2A 250Vac

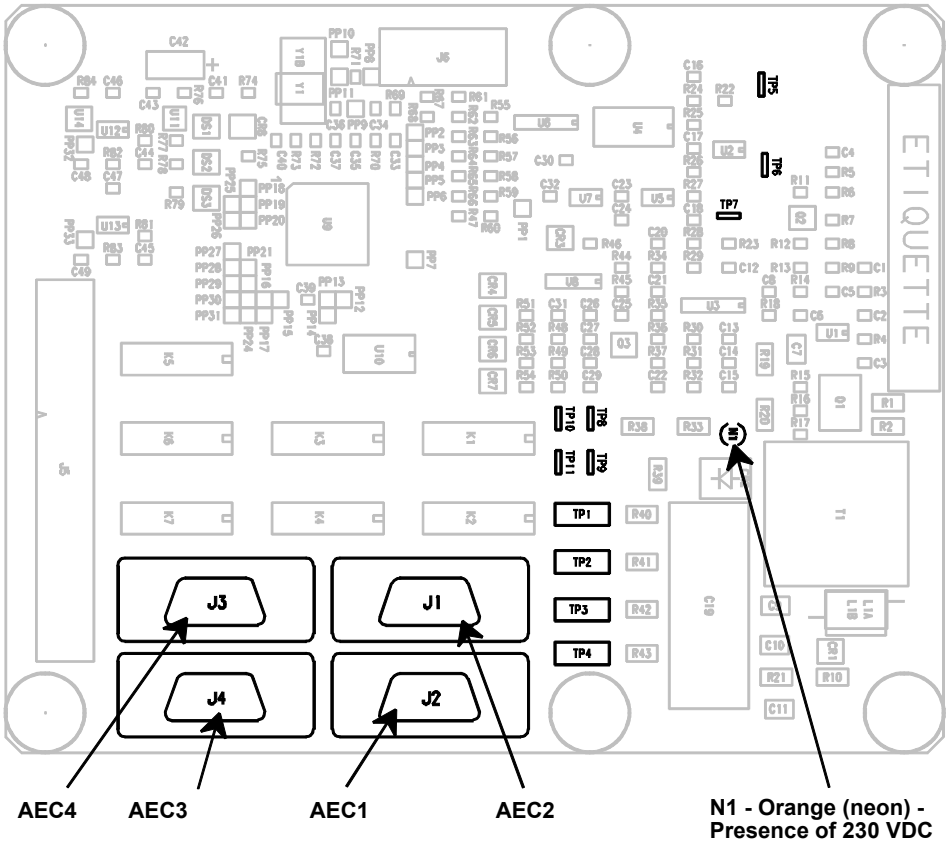
DS2: Orange light = presence of DC bus

WARNING:

HIGH VOLTAGE: DO NOT ATTEMPT TO SERVICE GENERATOR UNTIL DS1 AND DS2 (NEON - ORANGE) ARE EXTINGUISHED. EVEN WHEN THE LEDS ARE EXTINGUISHED, THE VOLTAGE COULD STILL BE OVER +90 VOLTS. CHECK THE DC BUS FIRST WITH A DVM BEFORE PERFORMING ANY SERVICE ON THIS PCB.

CAUTION:
Some components on this board can become very hot.

AEC PCB V2


J3
J1
J4
J2
TP1
TP2
TP3
TP4
TP7
N1
ETIQUETTE
AEC4
AEC3
AEC1
AEC2
N1 - Orange (neon) - Presence of 230 VDC

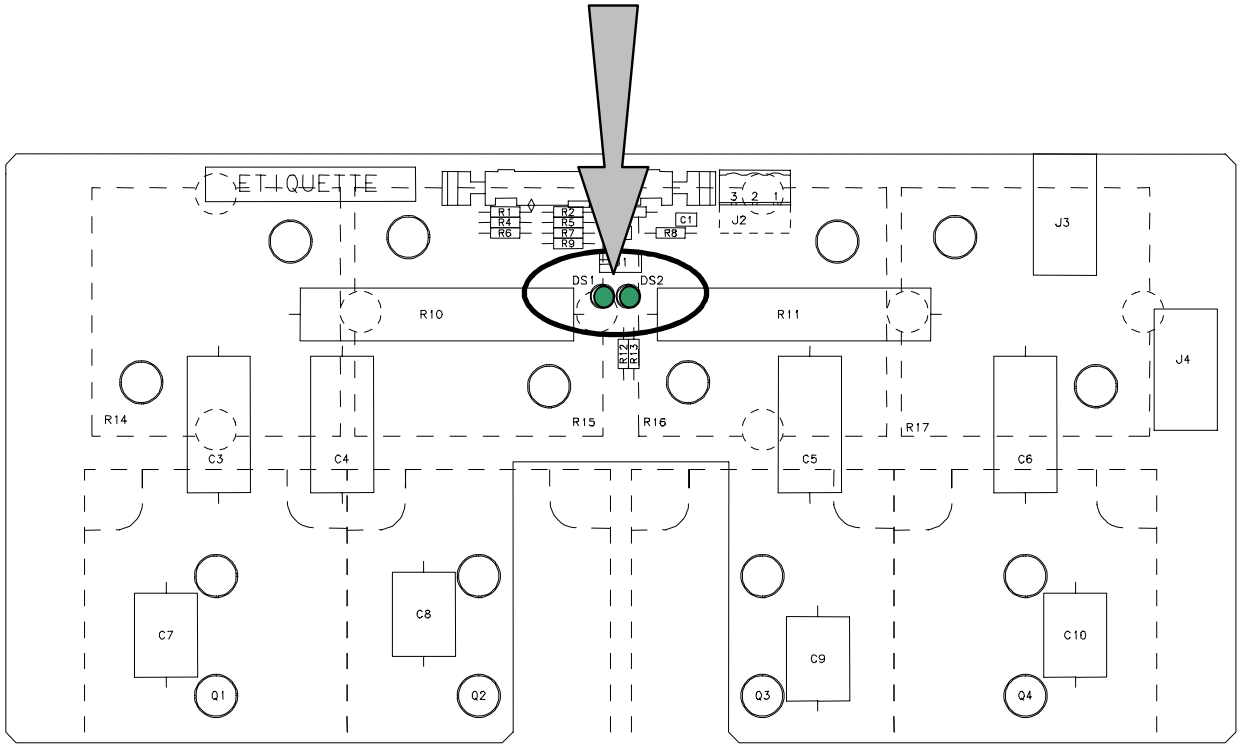
Test Points

TESTPOINT	MEASUREMENT	
	SIGNAL	RANGE
TP1	230 VDC	230 VDC _5%
TP2	230 VDC	230 VDC _5%
TP3	230 VDC	230 VDC _5%
TP4	230 VDC	230 VDC _5%
TP5	AEC assignment reference	0 to 10 V
TP6	10 VDC (reference)	10 VDC _1%
TP7	AEC return voltage	
TP8	AEC1 return voltage	
TP9	AEC2 return voltage	
TP10	AEC3 return voltage	
TP11	AEC4 return voltage	

IGBT PCB

WARNING: *High voltage: Do not attempt to service the generator until indicator DS1 (neon - orange) is extinguished.*

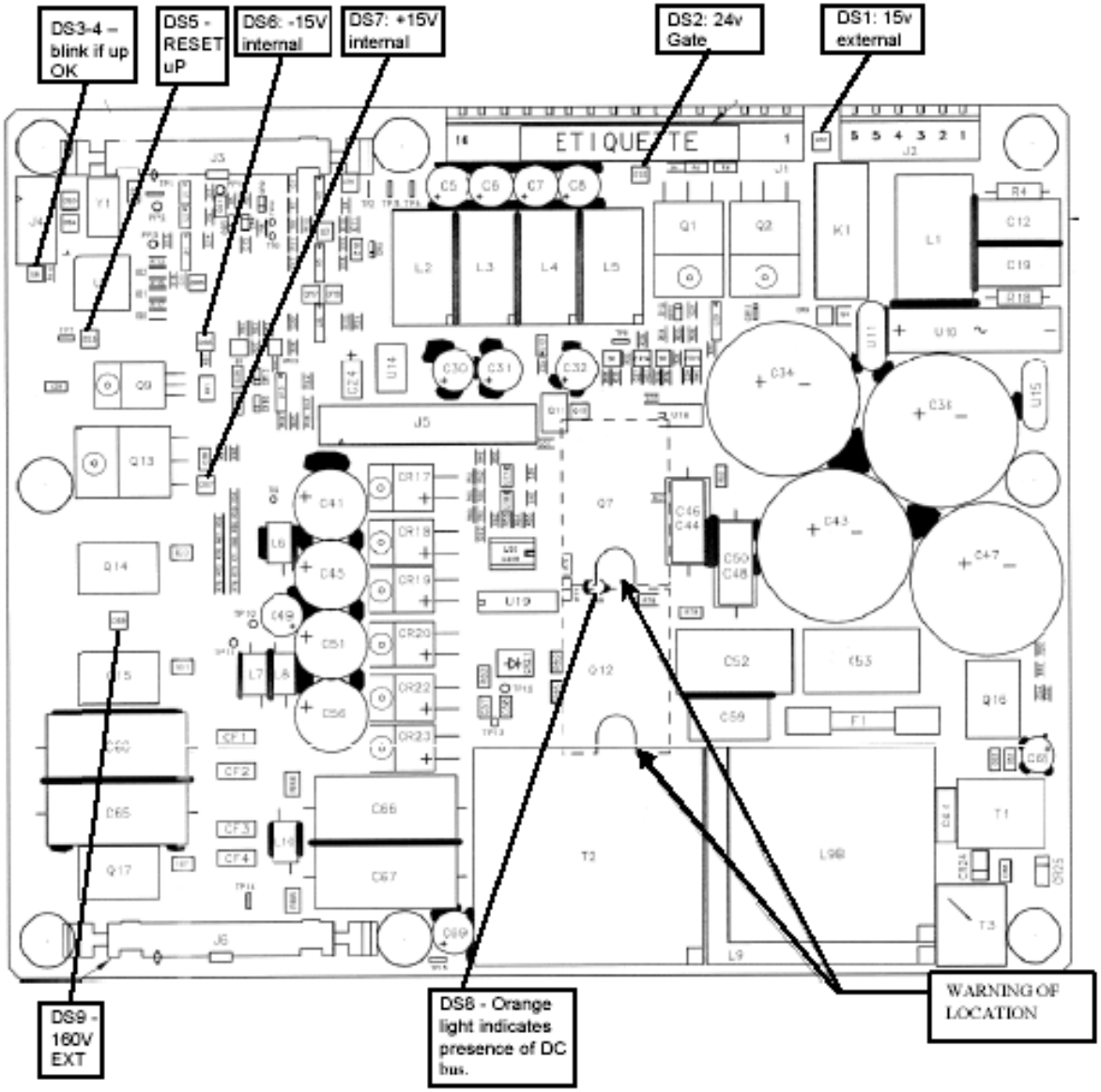
DS1 / DS2 - LED (green) - Indicates presence of voltage on DC Bus



LVPS-400 PCB

WARNING: *High Voltage: Do not attempt to service the generator until DS8 (neon - orange) is extinguished. Even when the LEDs are extinguished, the voltage could still be over +90 volts. Check the DC Bus first with a DVM before performing any service on this PCB.*

Caution: *The rectifier bridge on this PCB can become very hot.*


DS3-4 – blink if up OK
DS5 - RESET uP
DS6: -15V internal
DS7: +15V internal
DS2: 24v Gate
DS1: 15v external
ETIQUETTE
DS9 - 160V EXT
DS8 - Orange light indicates presence of DC bus.
WARNING OF LOCATION